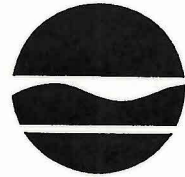**New York State Department of Environmental Conservation**
Division of Environmental Remediation
Bureau of Central Remedial Action, Room 228
50 Wolf Road, Albany, New York 12233-7010
Phone: (518) 457-1741   FAX: (518) 457-7925

John P. Cahill
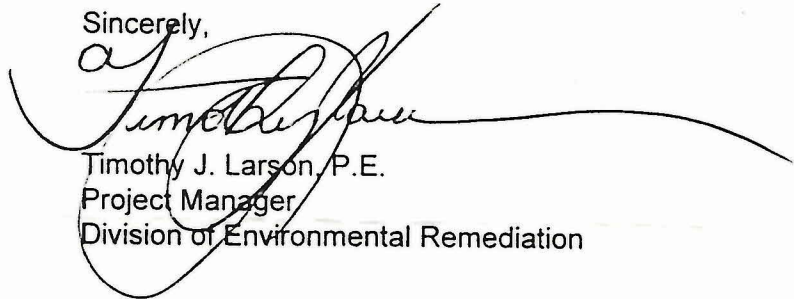Commissioner

May 27, 1999

Mr. Alfred J. Labuz, Manager
Site Remediation
AlliedSignal Inc.
1700 Milton Avenue
P.O. Box 6
Solvay, NY 13209-0006

Re: Onondaga Lake RI/FS - Ecological Risk Assessment (734008)

Dear Mr. Labuz:

As per your request at our April 15, 1999 meeting, on the Draft Ecological Risk Assessment for the Lake Bottom Site, I have enclosed a copy of our analysis of the Onondaga Lake macroinvertebrate data.

Sincerely,

Timothy J. Larson, P.E.
Project Manager
Division of Environmental Remediation

cc: Robert Ford - AlliedSignal
       Gordon Quin, Esq. - AlliedSignal
       Manning Gasch, Jr., Esq. - Hunton & Williams
       Leonard Sarapas - Dames & Moore
       John Davis - NYSDOL, NYC
       Norman Spiegel - NYSDOL, NYC
       Philip Bein - NYSDOL, NYC
       Robert Montione - NYSDOH, Albany
       Ronald Heerkens - NYSDOH, Syracuse
       Robert Nunes - USEPA, NYC
       Russell Nemecek - Onondaga Co. Health Dept.

ANALYSIS OF ONONDAGA LAKE MACROINVERTEBRATE DATA

QUALITY OF THE STUDY

Overall, the quality of the data produced by this study appears good. The methods appear sound, and the numbers of individuals and species are within expected ranges for benthic samples. Examination of the species list shows that the taxonomic proficiency is acceptable, based on the known occurrence of these species in New York State, and a reasonable expectation that they would be found in these habitats. The study is commendable for measuring the water depth at each sampling site. One limitation of the study was the lack of reference samples for stream sites; this limited the ability to assess the tributary samples of this study. Only taxa richness and abundance endpoints, and classification analysis were used to assess adverse benthic effects . A larger number of metrics with endpoints should have been used in addition to classification analysis.

CLASSIFICATION ANALYSIS

Although classification analysis is a valid technique for comparing sites, it is a relative comparison without absolute values, which therefore should not be used as the sole evaluation technique. Multimetric methods should be used in conjunction with classification analysis.

In the report, the sites were divided into three groups which were then assigned levels of alteration. It is not stated how these levels of alteration were assigned, though the criteria used are the whole crux of evaluating invertebrate data.

Metrics with endpoints, acceptable reference sites for the lake and tributaries (from which endpoints are derived), and expected biota concentrations should be used for assessment of impairment.

ADDITIONAL ENDPOINTS FOR CONSIDERATION

There is a multitude of metrics available to evaluate benthic invertebrate communities, including measures of species diversity, community balance, and presence/absence of sensitive species; these were apparently not used in this evaluation. A recent major paper concludes that both multimetric and multivariate approaches should be used in water quality evaluations: Reynoldson, T.B., R.H. Norris, V.H. Resh, K.E.Day, and D.M. Rosenberg, 1997. The Reference Condition: a Comparison of Multimetric and Multivariate Approaches to Assess Water-Quality Impairment Using Benthic Macroinvertebrates. J.N. Am. Benthol. Soc. 16(4): 833-852.

INTERPRETATION OF DATA

In interpreting data, four indices were used: species richness, dominance (percent contribution of three most numerous species), % oligochaetes, and richness of non-Chironomidae/Oligochaeta species (NCO), all based on pooled totals of five samples. These indices are ones that have previously been used in the evaluation of benthic invertebrate data. They were chosen here primarily because of their simplicity and ability to distinguish differences among the sites. Some of the ranges were adjusted to reflect the data being comprised of five pooled samples. Sediment/water quality was ranked into four categories ranging from non-impaired to severely impaired. The ranges used were, for non-impaired, slightly impaired, moderately impaired and severely impaired: species richness- >32, 25-32, 14-24, and 0-13; dominance- <61, 61-75, 76-90, and 91-100; % oligochaetes- <31, 31-50, 51-80, and 81-100; NCO- >15, 10-15, 5-9, and 0-4. Final assessments were based on the consensus of the four indices.

The 10 reference sites were assumed to be no more than slightly impacted. Based on the indices and using the ranges given, two of these reference sites were initially assessed as severely impacted and three were assessed as moderately impacted. As discussed below, water depth appeared to be the primary factor influencing the results. When samples from depths greater than 3.0 meters were eliminated (see below), the reference sites initially assessed as moderately- or severely impacted are eliminated, since these results are considered depth-impacted and not useful as reference data. The remaining five reference site sample sets were assessed as either non-impacted and slightly impacted, and serve to determine the ranges of the indices.

Depth appeared to play an important role in the invertebrate community composition. Of the sites assessed as slightly impacted, only 7% are from depths greater than 3.0 meters, while 49% of the sites assessed as moderately impacted are from depths greater than 3.0 meters, and 82% of sites assessed as severely impacted are from depths greater than 3.0 meters. This suggests that depth may be a primary determinant of community composition.

One method of separating out the sediment/water quality component from influences of depth is to compare only data from sites with comparable depths. To achieve this, sites with depths greater than 3.0 meters were provisionally eliminated; this included 51% of the sites sampled. The remaining sites were considered to be of comparable habitat, and water quality could be better judged. Using this method, most near-shore littoral sites are assessed as slightly impacted, with the exception of the southwest corner, which is assessed as severely impacted, and the southeast side which is assessed as moderately impacted. Using isobars to plot assessed sites, the remainder of the lake sites are seen to be at least moderately impacted. This method yielded equitable assessments, and the overall quality of the lake water and sediment could be evaluated without the deeper water site data.

The Sawmill Creek site (T15) and the Bloody Brook site (T11) were both initially assessed as non-impaired, using the lake benthic indices. NYSDEC kick sampling in these tributaries both before (1989) and after (1994-1996) the date of this study has shown these sites to be at least moderately impaired. This raises questions concerning the suitability of using lake benthic data to assess streams. No reference stream sites were sampled to gauge the accuracy of these assessments, but it is appropriate to use the kick sample assessments. Based on these, it appears inappropriate

to apply the lake benthic index ranges to the stream sample data. More appropriate assessments are obtained by provisionally assigning assessments of moderate impact to T1, T5, T11, T13, and T15, in agreement with kick sample assessments of these streams in 1994 sampling. A substantial decrease in indices occurs between these sites and T3, T7, and T9, which would then be assessed as severely impacted. The T3 site, Onondaga Creek, may be exempted from this assessment since it may be depth-impacted.

The final assessments using the above methods are:

NON-IMPACTED SITES: CR2

SLIGHTLY IMPACTED SITES: CR1, OT1, OT2, S35, S37, S47, S48, S53, S67, S73, S87, S100, S105, S110,

MODERATELY IMPACTED SITES: S13, S17, S21, S26, S34, S46, S61, S62, S74, S75, S76, S82, S93, S94, S111, T1, T5, T11, T13, T15

SEVERELY IMPACTED SITES: S2, S5, S14, S28, T7, T9

SITES CONSIDERED TO BE CONTROLLED PRIMARILY BY DEPTH: CR3, CR4, CR5, OT3, OT4, OT5, S7, S8, S9, S11, S12, S18, S19, S22, S24, S25, S27, S29, S38, S39, S40, S45, S51, S54, S55, S56, S68, S70, S71, S72, S77, S83, S84, S86, S90, S92, S95, S103, S104, S108, S109, S112, T3

Using the faunal assessments to determine water/sediment quality and make decisions concerning attainment, non-impacted and slightly impacted sites are considered "attaining" and moderately- and severely impacted sites are considered "non-attaining". The definition of "attaining" is achieving water/sediment quality such that designated uses are likely to be met. This method is consistent with Division of Water assessments of water quality. Based on these, most of Onondaga Lake (approximately 90%) would be considered non-attaining.

The bioaccumulation phase of the study showed that elevated bioavailability of mercury from Lake sediments may be largely localized. The results of the tissue analysis show that NYSDEC Division of Water's (DOW) levels of concern (representing approximately the top 2% of species/specific tissue concentrations of these contaminants found throughout the State) for mercury are exceeded at Station B2 in the amphipods and Stations B1 and B2 in the chironomids. This is based on the assumption that the DOW level of concern for crayfish is applicable to amphipods, and the DOW level of concern for caddisflies is applicable to chironomids. Bioavailabilty of mercury at these two sites also appears to be approximately 4 times that found at the other Onondaga Lake shallow sediment sample locations.

The impacts at the non-attaining sites appear to result from both organic and inorganic components. The sites with the most severe impacts, as well as the highest mercury concentrations in invertebrates, are in the vicinity of Metro and Harbor Brook. Station S14, which appears to correspond to Station B2, has the most limited fauna of all the littoral, non-tributary sites and also the highest concentration of mercury in invertebrates. Low biomass such as is exhibited at this site is usually attributable to toxicity. Inputs from the tributaries are probably also major

sources of inorganic contaminants. The area near the mouth of Harbor Brook appears particularly impacted.

ANALYSIS OF ONONDAGA LAKE MACROINVERTEBRATE DATA

The metrics used in this analysis were chosen primarily because of their simplicity and ability to distinguish differences among the sites. There are many other more sophisticated indices that could be used to analyze this data, such as diversity indices, or biotic indices, and it is preferable that several indices or metrics be used in a multimetric approach. The multimetric approach should be used to coalesce the metrics into a single overall assessment or ranking for each site.

SITE	SPP	DOM3	%OLIGO	NCO	IND	DEPTH	
NON-IMPACTED							
T15	43	44	23	27	1584	0.5	#
T11	41	54	18	20	1466	0.5	#
CR2	34	56	30	16	879	1.5	
OT3	33	77	06	22	3982	4.5 *	
SLIGHTLY IMPACTED							
S73	30	71	52	11	3301	1.5	
S48	28	47	18	14	1950	1.5	
S100	28	46	21	8	1835	1.5	
S110	28	64	55	10	3105	1.5	
S105	28	58	46	11	5723	1.5	
S87	27	58	40	11	4126	1.5	
CR1	25	70	61	8	1576	1.5	
S53	25	56	11	11	2438	1.5	
S67	23	67	58	10	2353	1.5	
S54	35	85	81	17	2317	4.5 *	
OT2	32	85	84	15	1192	1.5	
S47	30	88	86	15	3553	1.5	
S35	29	90	94	14	10622	1.5	
S37	28	92	93	13	8176	1.5	
OT1	28	86	75	10	1386	1.5	
MODERATELY IMPACTED							
S112	27	81	83	10	3098	4.5 *	
S45	27	81	80	11	6756	4.5 *	
S62	27	79	79	9	5432	1.5	
S26	25	72	52	8	1063	1.5	
S94	25	76	80	8	4216	1.5	
S95	25	78	66	7	3263	4.5 *	
S104	24	74	70	8	3718	4.5 *	
S109	24	77	80	8	3663	4.5 *	
S61	24	79	78	6	4883	1.5	

MODERATELY IMPACTED (Continued)

SITE	SPP	DOM3	%OLIGO	NCO	IND	DEPTH
S92	23	87	91	6	5422	4.5 *
S93	23	78	77	5	7639	1.5
S34	23	78	68	7	4413	1.5
S46	23	75	75	6	5952	1.5
S75	22	85	72	7	3605	1.5
S111	22	78	82	5	1581	1.5
S76	22	78	88	7	2880	1.5
OT4	21	89	9	9	3345	7.5 *
T13	20	84	56	9	1197	2.0 #
S83	20	93	81	6	3462	4.5 *
S74	18	77	80	4	1797	1.5
OT5	17	87	35	7	673	12.0 *
S82	17	94	80	5	3659	1.5
T1	25	94	92	13	1571	0.5 #
T5	25	92	95	11	4227	1.0 #
S71	23	88	83	8	5197	7.5 *
S17	21	90	93	8	8190	1.5
S38	20	93	96	7	7471	4.5 *
S11	19	85	88	6	12333	4.5 *
T7	18	78	14	3	352	0.5 #
S18	17	85	93	6	5236	4.5 *
S13	17	93	95	6	5324	1.5
S77	16	81	89	5	3721	4.5 *
S21	16	92	69	9	4416	1.5
S68	16	84	89	3	2002	4.5 *
S72	15	90	81	3	1745	4.5 *
CR3	15	85	80	2	1809	4.5 *
S12	14	88	98	4	8585	7.5 *

SEVERELY IMPACTED

SITE	SPP	DOM3	%OLIGO	NCO	IND	DEPTH
S55	13	82	87	1	1332	7.5 *
S5	12	79	68	0	2283	3.0
CR4	12	83	79	3	1060	7.5 *
S29	11	84	91	3	921	4.5 *
S28	13	96	99	3	2998	1.5
T3	11	92	99	3	1816	4.5 * #
T9	9	98	96	4	969	0.5 #
S7	10	93	91	2	6963	7.5 *
S19	9	87	99	0	1829	7.5 *
S108	9	89	15	0	453	7.5 *
S14	9	91	41	1	785	1.5
S2	9	81	68	2	2930	1.5

SEVERELY IMPACTED (Continued)

SITE	SPP	DOM3	%OLIGO	NCO	IND	DEPTH
S8	8	88	82	0	185	4.5 *
S84	8	91	90	1	2689	7.5 *
S22	7	88	58	0	103	4.5 *
CR5	7	91	82	2	234	14.0 *
S9	4	93	21	0	14	7.5 *
S39	3	100	31	0	16	7.5 *
S51	3	100	100	0	5	20.5 *
S70	3	100	0	1	4	14.0 *
S27	3	100	40	0	5	17.0 *
S25	2	100	33	0	3	13.0 *
S103	2	100	17	0	6	14.5 *
S56	1	100	100	0	1	17.5 *
S24	0	-	-	-	0	10.5 *
S86	0	-	-	-	0	16.0 *
S90	0	-	-	-	0	19.0 *
S40	0	-	-	-	0	17.5 *

* depths exceeding 3.0 meters; results not comparable
# stream samples; results not comparable